if he could do anything to get rid of them. He replied he could very easily. I warned him against using fire but he replied he had his own method that was perfectly safe. He turned up next day with a bundle of dried twigs and leaves of bramble, (I took this to be the wild Raspberry bramble). He tied this to a stick long enough to reach the ceiling under the porch where the insects had their entrance hole which was about an inch in diameter, and in the corner. He merely placed the stick against the wall so that the bundle of sticks and leaves blocked up incompletely the entrance hole, and left. He returned the next day by which time, there was not a mature hornet left. He then proceeded to take apart the walling and extracted an enormous hive full of young grubs which he took away with him to eat. I asked him the reason for the hornets forsaking their nest and he gave me a very amazing answer that the prickly thorns and hairs of the bramble tore their wings to pieces on their alighting on the bramble as they could no longer enter directly into their entrance hole.

I hope this Shan method will save a lot of people trouble in the future when confronted with nesting bees and hornets in their houses.

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25. OBSERVATIONS ON AN ASSOCIATION BETWEEN HORSE-FLIES (DIPTERA; TABANIDAE) AND CICADAS (HOMOPTERA; CICADIDAE), WITH A NOTE ON THE MATING OF CICADAS

During April, 1952, I frequently ate lunch in my car under a small acacia tree on the roadside near Mandya, Mandya District, Mysore State, India. At this season cicadas were extremely noisy, and since they seemed to be attracted to acacia trees, I found that my sandwiches were agreeably masticated to the tune of a deafening concert of luncheon music. Some of the insects were so near that I could reach out of the car window and touch them as they rested on the trunk of the tree. It therefore transpired that I was able to make notes of some of their activities.

Unfortunately I cannot state the specific identification of the cicadas, or of the horse-flies that will soon be mentioned. However, the following observations are related to behaviour that is more generic or familial than specific in character. In any event the story may have some intrinsic merit outside of taxonomic considerations.

The acacia tree was just coming into bloom. This meant that sap was probably flowing actively, despite drought conditions, and the attractiveness of the tree to sap-sucking insects was thereby explained.

Usually some ten or twelve cicadas were present. Practically all of these were distributed according to a courtship pattern, consisting of pairs, trios or quartettes, members of each group resting about six inches apart. Stridulation was intermittent so far as individual males were concerned, but it was rare that all males were silent simultaneously.

In any trio of cicadas, consisting of two males and a female, one male seemed usually to be in command facing the female head-on but also warily observing his rival. If the second male approached the female, the first one would walk in a 'threatening' manner towards the intruder. The threat, if such it was, expressed itself in a modified type of locomotion in which jerky steps were taken and the wings were partially spread, disclosing a red and black mark at the base of the hind pair. When the intruding male had retreated, the dominant one would resume his station near the female. No actual physical conflicts between males were seen.

Mating was observed once. A male in 'possession' of a female ceased stridulating and moved alongside his mate, both of them now facing the same direction. He threw three legs of one side over her body so that his own body partially overlapped hers. During the occupation of this stance, which lasted about ten seconds, the respective abdominal tips must have achieved union, for the male then stepped off and rotated himself through 180° with his tail as a focus. The pair then rested facing in opposite directions with their abdomens joined but with their wings covering the copulatory parts. They were now in a position commonly seen in many species of mating moths. During the time that copulation continued they did not move and the male was silent. On separating they moved apart to the original distance. Mating occurred between 1.00 and 1.15 p.m. on a hot day. The prolonged and intensive stridulating that took place before mating was achieved suggested either that female cicadas require considerable persuasion or that males are unusually timid.

A species of horse-fly of the genus *Tabanus* was also active on the acacia tree. These flies, singly or in pairs, moved deliberately along the trunk and branches. Their abdomens were marked with black and cream designs. The dichoptic females had prominent creamy markings on their legs, but the holoptic males had dark legs. A peculiarity of their locomotion was that they progressed chiefly by means of the meso- and metathoracic legs, using the fore pair more as feelers. The two front legs were put forward simultaneously in an outspread position and then adducted as testing the surface encompassed by their spread.

When the flies encountered a cicada, which was too often to have been only by chance, they approached as closely as possible. If they advanced from the front of the cicada, the homopteran would raise a fore leg in warning; if from the rear, the cicada, on becoming aware of the flies, would suddenly raise its wings and bring them down sharply, whereupon the flies would jump or fly back an inch or two. But again they would advance, sweeping the bark with their fore legs until almost in contact with cicada.

However, this was not always the end of the show, despite the fact that numerous cicadas could often be seen with their attendant flies in a state resembling an equilibrium of tensions. Occasionally a fly, seemingly warned by the cicada's lifted fore leg not to come closer, nevertheless passed beneath the leg and actually pushed itself under the cicada's body. The cicada even had to elevate itself slightly to permit the fly to crawl beneath it. The fly remained there only a few seconds and then emerged, to renew its station near the cicada.

Since it is known that not all species of *Tabanus* suck animal blood, but that some of them live on plant juices, it appears that in this instance the horse-flies were imbibing sap of the acacia tree from open lesions inflicted by cicadas. One exceptionally tame fly was examined through a hand-lens so closely that its proboscis could be seen inserted into one such traumatized spot. The sweeping action of the flies' legs as they traversed the bark of the tree must have been a tactile search for oozing sap. Their direct attention to cicadas must have resulted from the greater frequency with which fresh sap could be found near cicadas than on the general surface of the tree. When a fly actually crawled under a cicada to drink from the currently used wound, I could only think of a familiar sight in my native land —two children at a drugstore counter, their heads touching, drinking a milkshake out of the same glass with two straws.

Since cicadas lay their eggs in wounds in the bark of trees inflicted by their sharp ovipositors, it is possible that thirsty tabanids may take double advantage of cicadas. However, no evidence for this type of opportunism was obtained.

It remains only to wonder how 'real' the association between these cicadas and tabanids is, and to attempt a definition of the relationship. Judging by the behaviour of cicadas in response to the flies, I feel that cicadas are only mildly inconvenienced and scarcely ever annoyed. They accomplish their feeding, stridulating and mating as successfully as if the flies were not there.

The tabanids, however, had a definite dependence upon cicadas. Granted that any other mechanical force than traumatized tree bark could accomplish the flies' desired end, it so happened that cicadas were the only agents on hand to perform that vital service. It must be this circumstance that has led to present behaviour of tabanids in congregating on cicada-inhabited trees and in sometimes actually 'attending' the cicadas.

One would like to know whether the tabanids can hear cicadas at a distance and are attracted to, and concentrated upon, trees where unusual numbers of cicadas have assembled.

From the tabanids' standpoint, their association with cicadas is scarcely fortuitous. But since they neither benefit nor harm their benefactors, it would appear that the relationship is a kind of one-sided commensalism or symbiosis. It is likely that almost all forms of intimate association between living organisms, including parasitism, have originated following the establishment of an innocent pattern of behaviour such as the one just outlined. Since other kinds of tabanids have learned to suck blood, perhaps this species, a million years from now, may turn upon the cicadas and suck sustaining fluids directly from their bodies or eggs. Or perhaps they will learn to make their own incisions into the bark of trees. However unpredictable the outcome, it is clear that this short tale of natural history can by no means be viewed as a mere pretty recital of some events of contemporary insect life; it is fraught with potentialities for future evolutionary tragedy.

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